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DOCUMENT-IDENTIFIER: US 6386867 B1
TITLE: Method and system for imaging and modeling dental structures

Brief Summary Text (12):
Implementations of the above aspect may include one or more of the following. The air nozzle can be moved incrementally or continuously within the oral cavity. A motor may move the air nozzle incrementally or continuously within the oral cavity. The dental structure can be coated with a substance to enhance the image quality. An illuminator movably mounted on the intra-oral track can illuminate the dental structure. The illuminator can be moved incrementally or continuously within the oral cavity. A three-dimensional (3D) model of the dental structure can be generated based on the images captured by the image aperture. A stereometric analysis can be performed on the captured images. The method includes performing a scanning illumination beam and triangulation analysis on the captured images. The 3D model may be transmitted over a network. Diagnosis and treatment of a patient can be done with the 3D model.

Brief Summary Text (20):
Further, the system provides automated intra-oral scanning of all the dental structures in the jaw through an optical aperture and combines the information available in the entire set of images to create and present an accurate 3D model of the scanned structures. The system allows intra-oral images of dental structures to be taken rapidly and with high resolution such that the acquired images can be processed into accurate 3D models of the imaged dental structures. The images and models can be used in dental diagnosis and used for the specification and manufacture of dental prosthetics such as bridgeworks, crowns or other precision moldings and fabrications. In addition, the system produces 3D models useful in the diagnosis and treatment planning process for dental malocclusions. The system-produced data representing a set of dental images and models can be transmitted electronically to support activity such as professional consultations or insurance provider reviews, and the images and models may be electronically archived for future reference.

Brief Summary Text (21):
The digital 3D model of patient's teeth and other dental structures has advantages over a conventional cast physical model due to the following: 1) 3D model efficiently created in a single step with accuracy meeting or exceeding the conventional multiple step impression technique; 2)reduced storage costs; 3) immediate, labor-free retrieval and archiving; 4) no model breakage; 5) integrates directly into computer based analysis tools for diagnosis and treatment planning; 6) digital models backup; 7) e-mails to colleagues, dental specialists, insurance companies; 8) access to information from home, satellite office; 9) effective presentation tool; 10) no mess and dust; and 11) no wasted staff time.

Drawing Description Text (5):
FIG. 4 illustrates a process in capturing images and generating 3D models from a patient.

Drawing Description Text (11):
FIG. 10 illustrates a process utilizing air jets and spray orifices while capturing images and generating 3D models from a patient.

Detailed Description Text (14):
FIG. 4 shows an exemplary process 250 for scanning and generating 3D models of dental structures. First, the mouthpiece 130 is inserted into the patient's mouth (step 252). Next, a reset operation is performed to move the shuttle 204 to an initial known position (step 254). The illuminator 134 position, light spectrum and light strength is established (step 255). The image processor 110 receives an image through the image

aperture 132 and captures the image to its memory (step 256). The image processor 110 then instructs the image aperture 132 to traverse the arc track 210 over the dental structure to collect a sufficient number of images on both sides of the dental structure (step 258). The image processor 110 then actuates the drive mechanism 136 to move the shuttle 204 to the next incremental lateral position (step 260). At each lateral position, the image aperture 132 traverses the arc track 210 over the dental structure to collect a sufficient number of images on both sides of the dental structure before moving to the next lateral position. Next, the process 250 tests whether the shuttle 204 reaches the end of the patient's arch (step 262). If not, the process loops back to step 256 to continue the image acquisition operation. If the end has been reached, the process 250 generates a 3D model using the captured images (step 264) and displays the 3D model for review (step 266).

Detailed Description Text (16):
The CPU 300 executes code to control the image data acquisition and generate 3D models from the captured images. The captured images are processed with a pattern recognizer that maps various points of an object observed in the captured images, thereby obtaining the shape/contour information. In one implementation, 2D digitized images of the dental structures are output from the scanner 100 and stored in computer memory of the image processor 110 along with the positional information and illuminator settings. The stored images from a plurality of images obtained at different positions of the image aperture are then analyzed using stereometric methods to form a 3D view. This process is repeated for the complete set of captured images to create a full 3D model of the scanned dental structures in the oral cavity. The 3D model is then presented on a display or used in conjunction with a CAD/CAM system for patient diagnosis and treatment.

Detailed Description Text (35):
FIG. 10 shows an exemplary process 1250 utilizing an air nozzle and spray nozzle for scanning and generating 3D models of dental structures. First, the mouthpiece 130 is inserted into the patient's mouth (step 1252). Next, a reset operation is performed to move the shuttle 204 to an initial known position (step 1254). The illuminator 134 position, light spectrum and light strength are established (step 1256). The air nozzle 810 position and air flow characteristic are established (step 1258). The coating material spray nozzle 820 position and spray parameters are established (step 1260). The image processor 110 receives an image through the image aperture 132 and captures the image to its memory (step 1262). The image processor 110 then instructs the image aperture 132 to traverse the arc track 210 over the dental structure to collect a sufficient number of images on both sides of the dental structure (step 1264). The image processor 110 then actuates the drive mechanism 136 to move the shuttle 204 to the next incremental lateral position (step 1266). At each lateral position, the image aperture 132 traverses the arc track 210 over the dental structure to collect a sufficient number of images on both sides of the dental structure before moving to the next lateral position. Next, the process 1250 tests whether the shuttle 204 reaches the end of the patient's arch (step 1268). If not, the process loops back to step 1262 to continue the image acquisition operation. If the end has been reached, the process 1250 generates a 3D model using the captured images (step 1270) and displays the 3D model for review (step 1272).